

A novel eggshell pathology in

An increasing number of eggshell apex abnormalities are causing serious economic losses for egg producers in countries such as the Netherlands, South Africa and Japan. Since nutrition could not be the cause, animal health specialists looked at it and discovered the reason.

By Dr Anneke Feberwee and Dr Wil Landman, Animal Health Service (GD), Deventer, the Netherlands

Mycoplasma synoviae was first reported in 1953 by Olson and co-workers as an unidentified agent causing synovitis. Years later, Leece demonstrated that this agent was mycoplasma.

M. synoviae has been associated with respiratory disease and subsequent condemnations due to airsacculitis, although subclinical infections seem predominant. *M. synoviae* has also been associated with egg production losses albeit not unambiguously.

Despite the fact that respiratory *M. synoviae* infections are largely considered subclinical in nature and that studies on its effect on broiler performance and egg production showed conflicting results, an increasing number of reports documenting economic losses due to respiratory and arthropathic *M. synoviae* strains have been published during the past two decades. Moreover, the herein described eggshell pathology



Note the roughed aspect of the eggshell apex of an egg from a brown layer.

and concomitant egg production losses further increases the pathogenic potential and spectrum of *M. synoviae*, and thus its economic significance in commercial poultry.

Eggshell apex abnormalities

As from 2000 onwards, not previously documented eggshell apex abnormalities (EAA) were increasingly found in table egg producing layer flocks in the Netherlands. The EAA observed eggs that were characterised by altered shell surface (roughed aspect), shell thinning, and increased translucency. The eggshell abnormalities described were confined to the top cone of the egg and had a clear demarcation zone.

The economic impact per flock mostly paralleled the occurrence of defective eggshell top cones due to eggshell breakage, although total egg production was decreased as well. The production of EAA eggs was first described in white layers housed on cages and later also in brown layers housed in cages, and in both types of birds kept in other housing systems.

Recently the occurrence of this eggshell abnormality has also been reported in other countries like Japan and South Africa.

Economic impact

The economic significance of EAA is determined by egg production losses (up to 2-3 eggs per chicken) including loss of eggs due to breakage and soft shelled eggs, increased percentage of downgraded eggs (up to 5% during the whole production period) and increased labor costs due to the selection of EAA eggs and cleaning of the facilities due to broken eggs. The estimated average economic loss of a flock with 5% EAA eggs from 30 weeks up to 75 weeks of age is about 3% of egg price gross return.

Association with *M. s.* infections

Two different field studies have shown an association between the described egg shell pathology and *M. synoviae*.

The first study besides three non-EAA producing *M. synoviae* antibody-positive flocks included three *M. synoviae* antibody-positive flocks, which produced EAA eggs. Per flock 3-6 chickens were investigated.

The second study was a longitudinal field study of another affected flock.



Note the increased translucency of the affected eggshell apex at candling.

duced by *Mycoplasma synoviae*



Note the roughed aspect of the eggshell apex of an egg from a white layer.

Forty EAA egg producing white layers aged 70 weeks were housed in individual cages at the farm. Three weeks later half of the birds were individually treated with oxytetracycline. During 50 days the production of EAA eggs was recorded. Moreover, egg quality parameters from EAA eggs and normal eggs (including those of a non-EAA control farm) were quantified. At the end of the study birds were subjected to postmortem and mycoplasma culture and general bacteriology of the oviduct.

In both studies *M. synoviae* was isolated only from the oviduct of birds that produced EAA eggs or belonged to an EAA egg producing flock, but not from control flocks, while all categories were positive at *M. synoviae* serology. General bacteriology from the oviduct was always negative.

All birds included in the longitudinal study produced eggs with altered shell cones most of the time (50 day period). Egg compression tests showed a significant decrease in eggshell strength of affected eggs (15.9 Newton (N) n = 15 versus 34.1 N, n = 20 in controls). There was no effect on Haugh units and eggwhite thickness (mm). The antibiotic treatment with oxytetracycline improved the eggshell strength significantly (30.4 N, n = 13 at 1 week after treatment), however, the effect was temporary (13.9 N, n = 20 at 4 weeks after treatment). At postmortem no macroscopic abnormalities were observed in birds of the EAA farm (control and EAA producing birds) as well as the control farm.

The causative agent of EAA

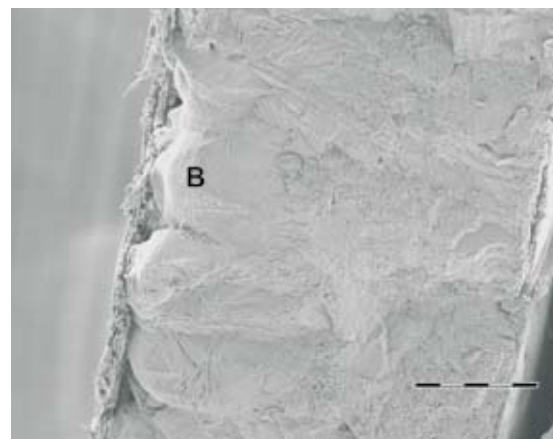
To prove the role of *M. synoviae* an oviduct isolate was used to infect (intratracheally - i.t.) commercial white laying hens. Besides a control group another group was also inoculated beforehand with IBV D1466.

No *M. synoviae* could be isolated from the oviduct of the control group (0/12). However, it was cultured from the oviduct of layers belonging to the *M. synoviae* i.t./IBV D1466 (6/17) and *M. synoviae* i.t. group (7/17), respectively.

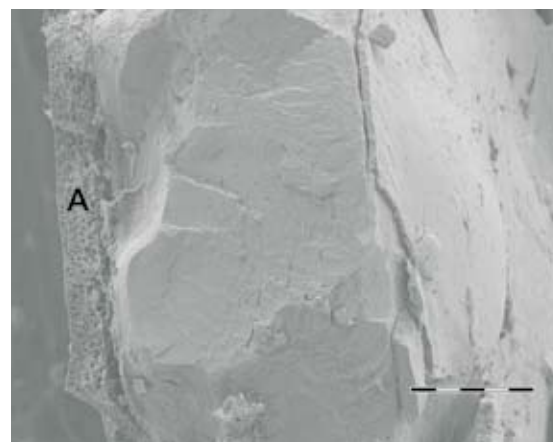
EAA eggs were produced in both *M. synoviae* infected groups: namely 49 EAA eggs in the *M. synoviae* i.t. group and 96 EAA eggs in the *M. synoviae* i.t./IBV D1466 group. The egg compression tests again showed a significant decrease in eggshell strength of affected eggs (16.8 N, n = 60) compared to that of eggs of the control group (37.7 N, n = 60). Scanning electron microscopy results also showed that the thickness of the calcified eggshell layer of the apex of an egg showing visible EAA was significantly decreased compared to that of a normal egg (average thickness being 212 μ m for altered eggshell and 311 μ m for the normal eggshell).

Conclusions

Both field studies demonstrated an association between the occurrence of EAA and colonisation of the oviduct by *M. synoviae*, while in an animal experiment a causal relationship was found between the newly described eggshell pathology and this mycoplasma species. Furthermore, a synergistic



Scanning electron micrograph of the cross section of the eggshell apex of a normal egg. Bar = 100 μ m.



Scanning electron micrograph of the cross section of the eggshell apex of an affected egg. Note the increased thickness of inner eggshell membranes (A) and the absent mamillary knob layer (marked as B in the picture above). Bar = 100 μ m.

effect between IBV D1466 and *M. synoviae*, resulting in a significantly higher production of EAA eggs, was found. The described eggshell pathology was characterised, amongst others, by a decrease in eggshell strength, which was restored temporarily after antibiotic treatment.

Although *M. synoviae* strains with tropism for synovial membranes and respiratory tissue have been described previously, here, we report for the first time the existence of strains with propensity to colonise the oviduct of layer chickens.

Due to the limited effect of antibiotic treatment and the risk of residues in consumption eggs, alternative strategies (e.g. vaccination) should be evaluated to control *M. synoviae* induced EAA egg production. ■